DOCUMENT RESUME

ED 388 211 IR 017 360

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TITLE Educational Multi-media in a Networked Society.
PUB DATE 94
NOTE 7p.; In: Educational Multimedia and Hypermedia, 1994. Proceedings of ED-MEDIA 94--World Conference on Educational Multimedia and Hypermedia (Vancouver, British Columbia, Canada, June 25-30, 1994); see IR 017 359.
PUB TYPE Reports - Evaluative/Feasibility (142) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Cognitive Style; Computer Interfaces; Computer Networks; *Educational Media; Educational Methods; *Educational Technology; Foreign Countries; *Futures (of Society); Institutional Role; Instructional Materials; *Multimedia Instruction; *Organizational Change; Telecommunications; Workstations

ABSTRACT

Multimedia is developing fast due to the convergence of different media (text, data. graphics, video, audio) into a common digital platform, and due to the convergence of telecommunications, television, and computing. Parallel to these technical convergencies is another set of developments in work and leisure that is opening up new markets for education and training, and which requires the creation of new institutional models. In the 21st century, work and learning will be inseparable. Learners will interact with their desk-top or portable workstations, determined by the nature of the learning task, and their preferred style of learning. Learners will need to access, combine, create, and transmit audio, video, text, and data as necessary. The workstation of the future will be a multipurpose machine, probably in modular form, including input and display devices, telecommunications, computing, and television. Key features will be the user interface, the tools available to the learner within the workspace, and a range of remote services that can be accessed via the workstation. The creation of new organizational structures will be critical for institutions to provide the administrative and educational support for lifelong learners. The heart of these support services is the internal multimedia network infrastructure that allows the institution to access, create, and deliver educational multimedia services in a variety of formats and modes. While schools, colleges, and universities will still have reason to provide campus-based learning, a great deal of learning will take place outside this context. Multimedia telecommunications allow learner-expert interaction, can be tailored to the individual, and encourage collaborative approaches to learning. As people learn through multimedia telecommunications, they will use the same tools and develop the same skills that will be an essential part of their work and leisure activities. (MAS)

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ED 388 211

Educational Multi-Media in a Networked Society

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Abstract: Multi-media is developing fast due to the convergence of different media (text, data, graphics, video, audio) into a common digital platform. However, there is another convergence that is also important: the convergence of telecommunications, television and computing. Parallel to these technical convergences is another set of developments in work and leisure that is opening up new markets for education and training, and which requires the creation of new institutional models. This paper explores the instructional and organizational implications of these developments.

Note: this paper is the summary of a multi-media presentation; most of the detail supporting this paper is in the presentation.

The technical and economic revolution

Multi-media in education has been seen by many primarily as an extension of computer-based learning. This is understandable, as some of the main constraints on computer-based learning have been the high cost of incorporating good graphics and video materials, and the restricted sensory stimulation for learners from screen-based text. The addition of high quality graphics, audio, and video to text, and more powerful editing and authoring software, provide a major enhancement of computer-based learning. The costs of hardware and the cost of producing multi-media materials are also dropping rapidly. 'Stand-alone' computer-based learning will become even more powerful as artificial intelligence and virtual reality develop. However, while 'stand-alone' applications of multi-media will continue to be important in education, a much more significant development will be the application of high-speed multi-media networks for educational purposes.

As well as the convergence of different media within a common computer platform, we are also seeing the convergence of the previously separate technologies and industries of computing, telecommunications and television. For instance, in April of this year, Stentor, an alliance of Canadian telephone companies, announced an $8 billion, 10 year initiative, called BEACON, that will bring broadband, multi-media services to 80%-90% of all homes and businesses in Canada by the year 2004. The social and educational impact of this convergence, and the speed with which it will be implemented, will be revolutionary and deeply challenging to established educational institutions.

At the same time as this technological revolution (and partly because of it), the needs of the workforce are also rapidly changing. In 1993, 78% of all jobs in the USA were in service industries, and the trend is likely to continue (Economist, 1994). Microsoft's annual revenues are greater than Sony's and Honda's combined, but they employ 100 times fewer workers. Most new jobs are being created in Canada by companies with less than 20 workers; indeed, the trend to both self-employment and working from home is likely to grow (StatsCan, 1992).

The wealth of nations will depend increasingly on knowlege-based, high-tech industries, in the areas of bio-technology, environmental products and services, computer software, financial services, and entertainment (particularly film and television). Furthermore, these are highly competitive, global industries. Keeping even a few months ahead of the competition, in terms of innovation and knowledge, are critical to survival, as is the quality of product and service. This means that education and training, not just in the pre-work years, but throughout a lifetime, are essential elements of a successful work-force. However, if every worker currently in the workforce was sent back to college for three months training every five years, we would have to double the post-secondary education system in Canada. In practice, of

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course, the political trend is to reduce or limit public expenditure, to make schools and colleges more cost-effective, to take greater numbers for less cost.

Multi-media and modern telecommunications do offer an opportunity to meet these lifelong learning needs of the work-force in a cost-effective manner. This will not happen though without thinking very differently about how education and training will be organized, in order to serve the needs of the work-force.

Learning in the 21st century

Modern learning theory sees learning as an individual quest for meaning and relevance. Once learning moves beyond the recall of facts, principles or correct procedures, and into the area of creativity, problem-solving, analysis, or evaluation (the very skills needed in the work-place in a knowledge-based economy - see Conference Board of Canada, 1991), learners need inter-personal communication, the opportunity to question, challenge and discuss. Learning is as much a social as an individual activity. However, for someone working in a small company, the nearest person with similar interests and expertise may be somewhere on the other side of the country, particularly in leading-edge technologies, and particularly in Canada.

Work and learning will be inseparable. Most learning will be informal and lifelong. It is not difficult to build a convincing portrait of learning at the work-place. We can envisage a computer software designer or television animation artist, called Sue, probably working from home, needing information on a certain technique or approach, or advice on how best to create a certain effect. From previous experience and contacts, or on the advice of a colleague, she has the name of someone half-way across the country (Wayne). From her work-station, Sue calls Wayne, talks about the problem, and Wayne loads up some software which he 'shares' with Sue via the network. Sue asks a few questions, tries a couple of things on-line while Wayne watches and comments, then downloads the software. Sue and Wayne are both registered with an educational institution that has been set up to enable the exchange of commercially sensitive material for learning purposes. Sue's work-station has automatically displayed the cost per minute of consulting Wayne, and the cost of rights for downloading the software. However, Sue was also able to give Wayne some information, and this is charged back to Wayne's account. Sue now not only has the software she needs, but also can contact Wayne (on a chargeable basis) any time she has a problem with the software. The learning context has been established. Note it is fragmented, on demand, and charged at cost.

Learners will interact with their desk-top or portable workstations in a variety of ways, determined by the nature of the learning task, and their preferred style of learning in the work situation. These preferred styles will vary considerably, both within a single person, depending on the task, and, for the same task, between different individuals.

The learning context will need to encompass the following:

- working alone, interacting with learning material (which may be available locally or remotely);
- working collaboratively (and in an equal relationship) with fellow workers at different remote sites, either synchronously or asynchronously: both these modes are likely to be multi-media;
- as an 'apprentice' or 'student', working with a more experienced worker, supervisor, or instructor;
- as an instructor, supervisor or more experienced colleague for other less experienced colleagues.

The same person may find themselves in each of these roles within a single working day. Learners will also need to be able to work from home, or from a work-site, or while in transit. They will need the following:

- access to information (searching, downloading) from multiple sources in multiple formats
- selection, storage and re-ordering/re-creation of information
- direct communication with instructors, colleagues, and other learners
- incorporation of accessed/re-worked material into work documents
- sharing and manipulation of information/documents/ projects with others.

Learners will need to access, combine, create and transmit audio, video, text, and data as necessary.

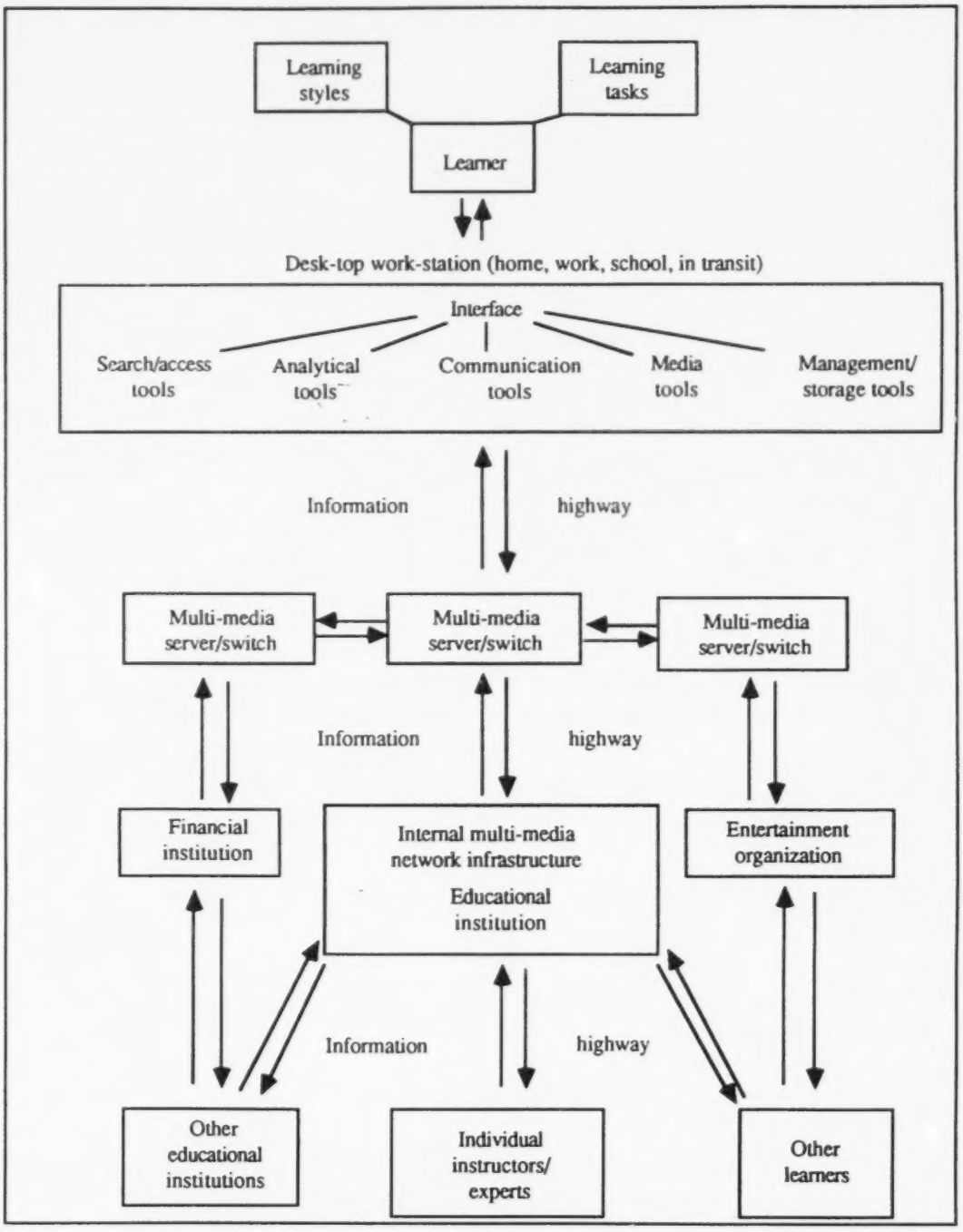

Figure 1: A networked educational multi-media system

If we take this as the design requirement, there is then a need to build *systems* that support this form of learning, both for formal and informal learning. I give my own personal 'vision' of how such a system would provide the kind of educational experiences I would like to see. This is summarized in Figure 1, above.

The work-station

Arguments about whether access to the information highway will be through a personal computer or a 'converter' on a television set miss the point. The work-station of the future will be a multi-purpose machine, probably in modular form, including input (voice, pen, keyboard, gestures) and display (screen, sound, printer) devices, telecommunications, computing and television. It will be at least in part portable.

Key features will be the interface between the user, the tools available to the learner within the workstation, and a range of remote services, both educational and non-educational, that can be accessed remotely via the work-station.

The interface

Design work has already begun on building interfaces for the information highway. The Virtual Interactive Environment for Workgroups (VIEW) is one such system currently in the initial stages of development in Canada by MPR Teltech, the Open Learning Agency, Simon Fraser University, Science World (British Columbia), the British Columbia Educational Technology Centre, and Stentor. The VIEW system will provide tools for creating and using 'multimedia conferences', and for enabling users to engage in individual and collaborative group activities using information from diverse sources and in a variety of media formats, operating either in synchronous or asynchronous modes (Teles and Laks, 1993).

In essence, when learners switch on their work-station, there is a window with a choice of services. One of the choices (others may be films, home shopping, financial services, messages, etc.) will be education and training. When the learner chooses education and training, VIEW will provide a new window, with a choice of educational services, and a choice of a range of software tools to facilitate the learning and communication process. Thus learners will be able to search, access and download information from a variety of sources in a variety of media formats. An example of how this will work is given in the presentation.

The tools

A critical element are the software tools available in the work-station. As well as tools for communication, management and storage of information, there will also be tools that assist in searching, accessing and compressing information, in analysing accessed data for relevance, in 'grouping' appropriate types of information, and tools for importing different types of media-based information, editing, and exporting them. These tools will need to be intuitively simple to use.

The educational institution

What will make or break such a system will be the creation of new organizational structures for educational institutions to provide the administrative and educational support for lifelong learners.

Roles for 'electronic' educational institutions

The critical roles of an 'electronic' educational insitution built to meet the learning needs of the 21st century will be as follows:

- to provide information on education and training needs and opportunities
- to provide quality control
- to provide accreditation, through independent assessment of learning
- to develop coherent curricula, where appropriate

- to provide the service that will make the use of communications to import and export multi-media learning materials easy and user-friendly
- to network learners and instructors
- to create high quality educational multi-media materials in an easily accessible form
- to conduct research into education and training needs
- to apply new technologies, as they develop, to education and training, and to evaluate their use.

Note though that many of the instructors or tutors that are used will not 'belong' or work for the educational institution; many will be independent contractors, or working full-time in a knowledge-based industry, or working for another educational institution. Nor will learners necessarily be 'registered' with that institution, in the sense of taking all or any courses. The institution is primarily a facilitator of learning. In the example of Sue and Wayne, all the educational institution may do is bill, and collect and deliver payment, regarding fees and royalties, to and from Sue and Wayne, the owners of the software, and possibly the telecoms companies (plus a service charge). In other cases, it may offer a full program to groups of students with its own instructors and multi-media materials, leading to its own credential. In others, it will be like a multi-media reference library, with learners just accessing the information they need. It will be quite a commefcial organization, collecting fees for many of its services, where this is appropriate.

The internal multi-media network infrastructure

The heart of this service is the internal multi-media network infrastructure, that allows the institution to access, create and deliver educational multi-media services in a variety of formats and a variety of modes. The Open Learning Agency is developing an integrated information management approach that will include both administrative and instructional systems. Basically, learning materials can be accessed, created and stored digitally in any format (video, audio, text, graphics, or any combination). Course designers can access this material electronically, re-edit and re-create learning materials, store and export this learning material in a variety of ways (print, CD-ROM, or down-loaded to local work-stations), depending on the learners' needs. The system will allow for the tracking of materials and services, the on-line payment of fees and charges for services, and student or client record-keeping (including grades and credentials), as well as providing management information on finances and learner activities. This infrastructure is connected through the information highway to multi-media servers or switches. More details of the Agency's plans for its internal multi-media network infrastructure are given in the presentation.

Implications for learning

While schools, colleges and universities will still have reason to provide campus-based learning to groups of learners over set terms or semesters, for social and for some instructional reasons, a great deal of learning will take place outside of this context. Full-time students will in any case soon be a minority in Canadian universities and colleges (63% of all college enrolments in British Columbia were part-time in 1992/93 - B.C. Ministry of Skills, Labour and Training, 1993). Even for full-time students, it will be difficult to categorize them as either 'campus-based' or 'distance education' students within a few years. They will be accessing information and communicating with their instructors, other students, and other subject experts outside their own institution, through multi-media telecommunications, from home and the work-place. Furthermore, multi-media telecommunications will allow them to do this whenever they want, in small chunks as well as in whole courses or programs of study, thus making learning more flexible and accessible, to all ages of learners, and not just young people in the formal system. Learners will also have a much wider choice of sources of learning, being able to access expertise from anywhere in the world.

As important as the context of learning will be the approaches to learning and instruction. Multi-media telecommunications will allow learners and subject experts to engage in dialogue, questioning, and exploration of a wide range of alternative approaches, as well as the sharing and joint working of multi-media documents. Programs and instruction can be tailored to the needs of each individual. Multi-media telecommunications can also encourage collaborative approaches to learning. Learning will often occur without the direct intervention of a 'formal' instructor, through the use of peers and people working in a job

but who have expertise. Most important of all, as they learn through multi-media telecommunications, people will use the same tools and develop the same skills that will be an essential part of their work and leisure activities. 'Stand-alone' multi-media applications will still have an important role to play, especially where learners need to work through carefully a disciplined set of principles and ideas, or need a great deal of practice and experiment to fully understand a subject of study. Their use will increase if learners are given the opportunity to re-work and re-create their own multi-media applications, as projects or for the purposes of assessment. However, stand-alone applications will be a specialized and relatively limited use of multi-media within a much richer learning environment, that will include two-way communication and the transporting of multi-media materials between learners, and between the learner and a mentor. (More details of the different curricula approaches made possible through multi-media telecommunications are given in the presentation - see also Bates, 1993).

Conclusion

This vision for a system is not a utopia, nor even many years away. The wideband highways are at this moment being constructed, and should be in place within 10 years. Multi-media switches, using ATM technology, are now being built. Interfaces to the information highway, and software tools to facilitate multi-media learning, are being designed. The software for handling multi-media communications is being developed by companies such as Oracle.

However, the most difficult part of the system to put in place will be an appropriate educational infrastructure to support the kind of learning needed in the 21st century. The provision of appropriate education and training services to run on the information highway is critical; there is no automatic guarantee that people will use the information highway to an extent that justifies the cost of investment, if services are not provided that meet people's needs. Unfortunately, existing educational institutions were created to meet the needs of a society that are fast disappearing. We need new educational organizations that can exploit the information highway to meet the needs of the 21st century. Economic development will depend as much on the success of creating and supporting such organizations, as on establishing the technological infrastructure. It is critical to get this right because there is no doubt that those countries that harness the power of multi-media communications for education and training purposes will be the economic powerhouses of the 21st century.

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